PROGRAM REVIEW 1985-86

NORTHERN FORESTRY CENTRE
CANADIAN FORESTRY SERVICE
1986

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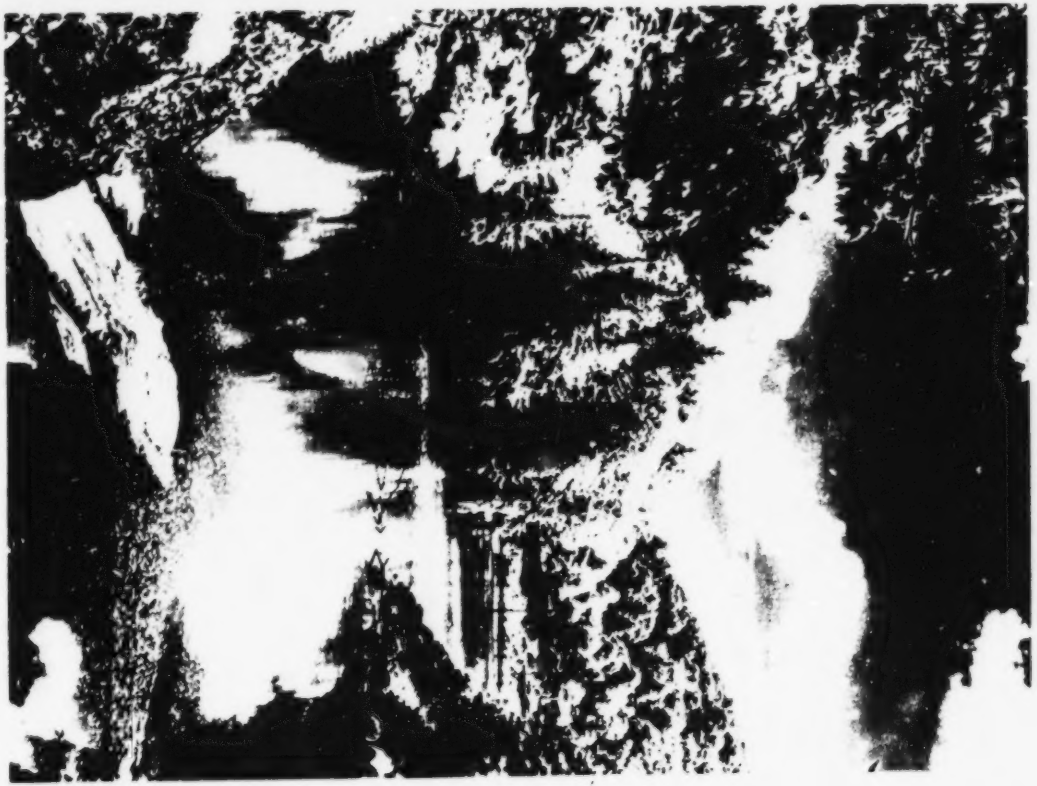


The Canadian Forestry Service

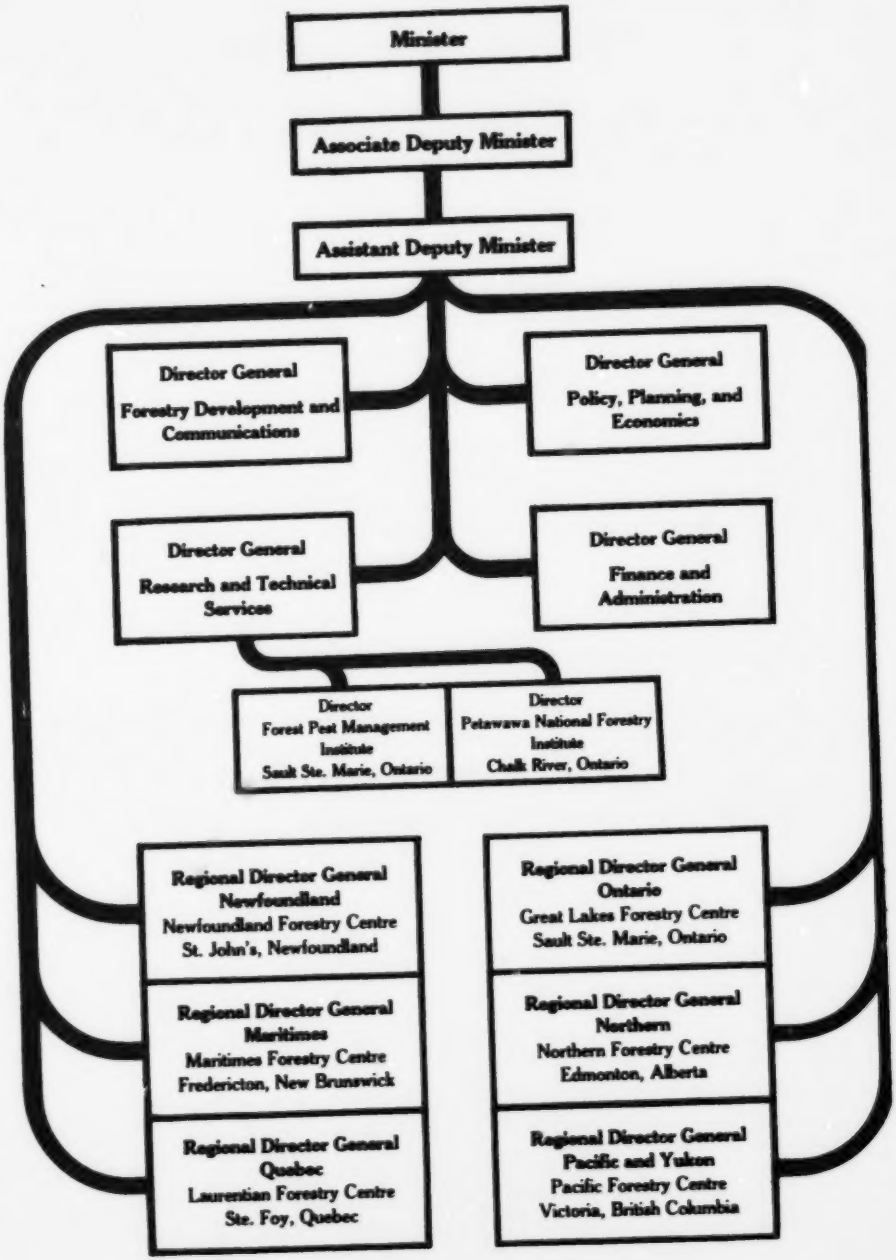
The Canadian Forestry Service (CFS) is the principal source of federal expertise in forestry. Its general objective is to promote the wise management and use of Canada's forest resources for the economic, social, and environmental benefit of Canadians.

The following are the main functions of the CFS:

1. coordination of federal policies, for the promotion of better resource management and forest industry development;
2. provision of scientific and technological leadership in forestry through research and development;
3. provision and analysis of national and international statistics and information as a basis for policy formulation;
4. development and certification of codes and standards for wood product performance;
5. protection of Canada's forests from foreign pests;
6. fostering the potential use of the forest resource for energy;
7. contributing to the environmental objectives of the Government of Canada.

A number of federal agencies are involved in forestry programs, and a Federal Forestry Sector Strategy Committee has been established to coordinate federal forestry activities. The Canadian Forestry Service has been designated the lead agency.

The Canadian Forestry Service is comprised of a headquarters unit, six forestry centers, and two national institutes. The forestry centers are responsive to regional priorities and maintain close liaison with the respective provincial government forestry departments and other clients. They also participate in, and frequently lead, national programs. The national institutes provide the focus for programs of national scope.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Pacific Forestry Centre
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Le service canadien des forêts

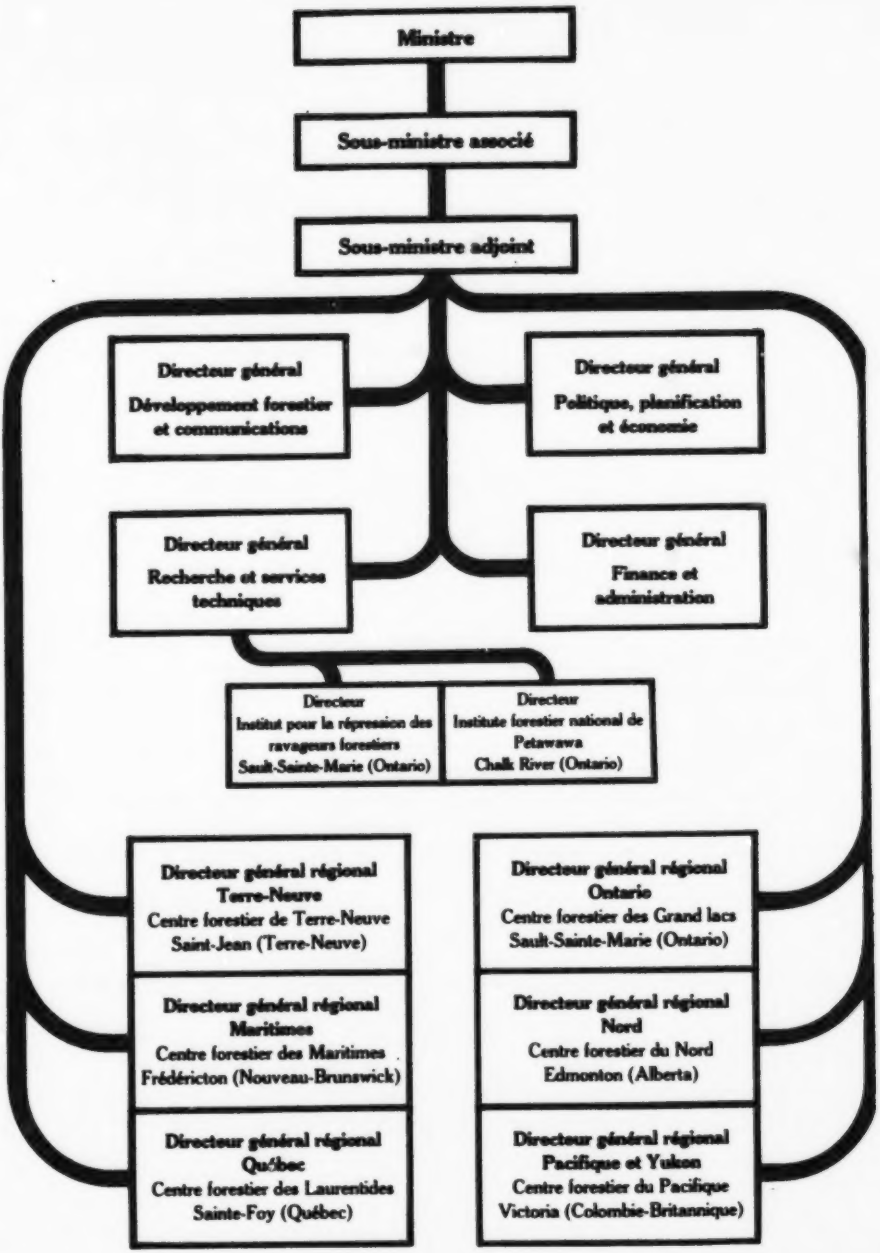
Le Service canadien des forêts (SCF) réunit la majorité des spécialistes fédéraux en foresterie. Son objectif général est de promouvoir l'aménagement et l'utilisation judicieux des ressources forestières du Canada pour le plus grand bien économique, social et environnemental des Canadiens.

Voici les principales fonctions du SCF:

1. coordonner les politiques fédérales afin de favoriser l'amélioration de la gestion des ressources et l'expansion de l'industrie forestière;
2. fournir une orientation scientifique et technolgique dans le domaine de la foresterie, par la recherche et le développement;
3. fournir et analyser les statistiques et l'information nationales et internationales qui serviront à établir les politiques;
4. mettre au point et homologuer des codes et des normes en matière de rendement des produits du bois;
5. protéger les forêts canadiennes en luttant contre les ravageurs étrangers;
6. parrainer l'utilisation éventuelle des ressources forestières pour la production d'énergie;
7. adhérer aux objectifs environnementaux du gouvernement fédéral.

Divers organismes fédéraux participent aux programmes forestiers, et un comité de la stratégie forestière fédérale a été créé pour coordonner les activités fédérales en matière de foresterie. Le SCF a été désigné organisme directeur.

Le Service canadien des forêts comprend une administration centrale, six centres forestiers et deux instituts nationaux. Les centres forestiers doivent répondre aux impératifs régionaux et entretenir une liaison étroite avec les ministères provinciaux des Forêts. Ils participent également à des programmes nationaux dont ils assument fréquemment la direction. Les instituts nationaux sont les foyers des programmes d'envergure nationale.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Centre forestier du Nord
Edmonton (Alberta)
Directeur général régional
Pacifique et Yukon
Centre forestier du Pacifique
Victoria (Colombie-Britannique)

CONTENTS

Page

Director's Report 1

Forest Protection Research
- NOR-7 Environmental effects of toxic substances and vegetation management ... 4
- NOR-11 Forest insect and disease surveys and management systems 6
- NOR-28 Wetlands, climate, and ENFOR 8

Forest Resources Research
- NOR-4 Stand productivity and forest inventory 12
- NOR-10 Regeneration and plantation management 15
- NOR-12 Nursery management and tree improvement 18

Forestry Extension
- NOR-5 Fire management systems and guidelines 22
- NOR-13 Forest hydrology and microclimate research 24
- NOR-33 Technology transfer and information 25
- NOR-53 Computing and data processing services 27

Regional Development
- NOR-3 Forest resource economics and statistics 30
- NOR-36 Development agreements 32
  - NOR-36-01 Canada-Manitoba Forest Renewal Agreement (Manitoba District Office) 32
  - NOR-36-02 Canada-Alberta Forest Resource Development Agreement and development program coordination (Northern Forestry Centre) ... 33
  - NOR-36-03 Canada-Saskatchewan Forest Resource Development Agreement (Saskatchewan District Office) .....
- NOR-54 Management of regional development program 37

Management Services
- NOR-51 Financial, administrative, and support services 40

Appendixes
- A — Organization chart 41
- B — Staff listing 42
- C — Expenditures 47
- D — Cost-shared agreements 48
- E — Contracts let or supervised 49
- F — Publications 56

Director's Report

I am pleased to report that the year just passed was again a significant one for the Canadian Forestry Service (CFS) in the prairie provinces and Northwest Territories. It was the first full year of operations under each of the three federal-provincial forest resource development agreements in Alberta, Saskatchewan, and Manitoba. Program planning and implementation proceeded on schedule and resulted in the development of over 100 projects worth about $7 million in federal funds. The Saskatchewan and Manitoba district offices, with 12 and 16 employees, respectively, were officially opened by the Hon. Gerald Merrithew, Minister of State (Forestry). The district offices have enabled the CFS to more-adequately fulfill its role and responsibility in the region, particularly as it pertains to the delivery of programs under the federal-provincial forest resource development agreements.

The Senior Regional Advisory Committee, concerned with information exchange and program issues and priorities at the regional level, met in November 1985 at the Northern Forestry Centre (NoFC) in Edmonton. The committee (comprising senior officials from provincial governments, the forest industry, the University of Alberta, and the CFS) has established three technical committees—forest fire, reforestation, and insects and diseases—to encourage coordination of programs and to identify new opportunities for research and technology transfer. At the provincial level, Memorandums of Understanding (MOUs) Concerning the Coordination of Forest Research are in place and provide for the fullest and most effective and efficient use of the forest research resources in each jurisdiction. The research committees under these MOUs have been instrumental in developing multi-year research plans and in allocating resources from each of the three federal-provincial forest resource development agreements to ensure that research priorities and goals are tackled.

The Northern Forestry Centre participates in a number of national projects. In cooperation with the Great Lakes Forestry Centre in Sault Ste. Marie, a national silviculture equipment inventory has been developed and is now available to users. The Forest Insect and Disease Survey staff have established and measured 10 permanent sample plots as part of a long-term program to monitor acid rain effects on plant foliage and soils in Canada. Our Centre is responsible for the periodic updating of statistical information on silviculture activities in Canada; in early 1986 we published *Silviculture statistics for Canada, 1975–76 to 1982–83*. NoFC fire researchers continued to play an active role on the CFS Fire Danger Working Group and coauthored an interim edition of the Canadian Forest Fire Behavior Prediction System.

Several research projects are being terminated or have reached the application stage. The Marmot Experimental Watershed Program, initiated in 1962, is to be terminated in late fall of 1986. This major program has provided practical management prescriptions and guidelines that will help stabilize and improve the quantity and quality of water from forested areas. The jack pine improvement project, initiated about 20 years ago, has produced genetically improved

material for the establishment and development of several jack pine seed orchards under the Canada-Manitoba Forest Renewal Agreement. Similarly, the first operational large-scale photo system, based on research and a prototype version developed by NoFC scientists, has been completed for use in the Yukon Territory.

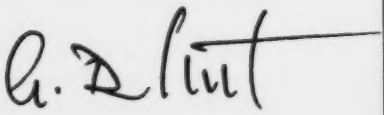
A report on a major study concerning effects of oil sands emissions on the boreal forest has been completed. This is a consolidation of 10 years of cooperative work between the CFS and Alberta Environment in the area of air pollution impacts.

Incremental research funding under each of the three federal-provincial forest resource development agreements has generated new research studies too numerous to mention. A new vegetation management project has been initiated involving researchers from three NoFC projects (Regeneration and Plantation Management, Resource Economics and Statistics, and Environmental Effects of Toxic Substances and Vegetation Management) and staff of the Research and the Reforestation and Reclamation branches of the Alberta Forest Service. This project will test silvicultural, environmental, and economic aspects of manual, mechanical, and chemical treatments for the purpose of site preparation and conifer release. Another initiative involves evaluation of the effects of drainage on the hydrology of wetlands and the enhancement of tree growth.

The Northern Forestry Centre celebrated 15 years of operation by convening a very successful Open House event during National Forest Week in May 1985. Following a tree-planting ceremony involving the Hon. Gerald Merrithew, the Centre opened its doors to the general public as well as groups of youngsters from the various schools and associations interested in forestry.

Management and staff of NoFC continue to strive toward excellence in the research effort and effective delivery of programs under federal-provincial agreements. To this end, we will continue to rely on the cooperation and support of clients and collaborators in the region as well as nationally.

A.D. Kiil
Regional Director General



Forest Protection Research

NOR-7

Environmental effects of toxic substances and vegetation management

Objectives: To determine the impact of pollutants on native soils and forest ecology; to provide federal, provincial, and industrial resource managers with advice on the assessment of air pollution impact on forest soils and vegetation; to determine the fate of herbicides and herbicide residues used in forestry applications in native soils and the impact of herbicides on native plant communities and key species; to determine the influence of herbicide application and other silvicultural practices on the long-term stability of nutrient balance and the biological and chemical control of tree nutrient requirements and uptake; to assess the impacts of industrial development on the terrestrial environment and recommend measures for mitigating the damaging impacts of the proposed developments; to provide analytical services to NoFC as required by ongoing research studies and develop new analytical techniques as required.

Achievements: Descriptive studies on the pattern and impact of pollutant deposition in several industrially developed areas have been completed. Both laboratory and field studies on soils and plants have produced biomonitoring techniques. Studies have been carried out on the interaction of environmental and biotic factors that influence the impact of a pollutant on forest species. The results have indicated that it is very difficult to predict pollutant impact on a plant species in the field because of the tremendous variability and complexity of forest ecosystems, especially in situations where the pollutant effects are soil mediated. One of the descriptive studies indicated that there is possibly a 2-year lag between the onset of significant sulfur (S) dusting and substantial S oxidation and subsequent pH drop. Studies have also been carried out to determine the effects of elemental S concentration, nutrient availability and source of S-oxidizing microorganisms on the Thiobacilli, sulfur dioxide (SO_2) generation from sour gas plants, pH, and solubility of other elements. Effects of SO_2 exposure on photosynthesis in pine and aspen cuttings from the Athabasca Oil Sands and on the lichen *Evernia mesomorpha* have been studied, and several publications were published. Several articles on the influence of pollutant deposition or uptake on plant communities and soil chemistry and biology have been published.

A new study on the environmental impacts of forest vegetation management techniques, including herbicides and their residues, has been designed, and a work plan for interdisciplinary research on the study was prepared and implemented.

Investigations of the distribution of radionuclides around uranium mining and milling operations in the Uranium City area were carried out. A paper was published on fission track mapping of black spruce.

An active role was played in preparing guidelines for ARNEWS (Acid Rain National Early Warning System) plot selection, sample collection and preparation, and chemical analysis of ARNEWS samples, including those from the Pacific Forestry Centre in Victoria.

In addition, all NoFC studies were reviewed for environmental implications, and work was undertaken on the effects of herbicides on selected mycorrhizal species. Impact assessment and preliminary results of both field and laboratory studies have been presented to Canterra Energy Ltd., Gulf Canada, provincial environment departments, and other appropriate agencies.

1986–87 objectives: To publish journal articles on the influence of pollutant deposition or uptake on plant communities including lichens, soil chemistry and biology, and vascular plant physiology and on uranium mining and milling and radionuclides in the terrestrial environment; to continue to measure the rate and effect of pollutant deposition on soil chemistry and tree response; to reexamine biomonitoring plots around sour gas plants; to establish a bench-mark study on the impact of vegetation management methods, including herbicides; to establish a herbicide residue analytical laboratory; to complete experiments on the effects of hexazinone and Roundup on in vitro growth of mycorrhyzae; to initiate studies on the fate of herbicides and herbicide residues in forest soils and vegetation and on the influence of herbicide application and other silvicultural practices on the long-term stability of nutrient balance and the biological and chemical control of tree nutrient requirements and uptake; to provide analytical services to NoFC as required by ongoing research studies.

Studies:

Assessment of air pollution impact on forest systems and of industrial development in natural areas

Impact and residue chemistry of forestry herbicides

Environmental impact of silvicultural practices on soil-plant nutrient dynamics, tree growth, and physiology

Analytical services laboratory

Project leader:
Dr. P.A. Addison
(Transferred to Ottawa in Oct. 1985)
Dr. S.S. Sidhu
(From Nov. 1985)

Professionals:
Dr. M.J. Apps
J. Feng
Y.P. Kalra
Dr. D.G. Maynard

Technicians:
M.D. Fairbarns
L.J. Milward
(From March 1986)
F.G. Radford
J.I. Ridgway
J. Shuya

NOR-11

Forest insect and disease surveys and management systems

Objectives: To gather new knowledge of major forest insects and diseases for the purpose of understanding and minimizing damage attributable to these organisms; to contribute to a national overview of important forest pests, acid rain pollutants, and other damaging agents and their effects on forests and vegetation; to conduct research on the biology and damage impact of specific insects and diseases and to determine the effects of ice-nucleating agents on cold tolerance of seedlings; to maintain reference collections of insect and disease specimens; to conduct quarantine-related surveys.

Achievements: Infestations of important insects and diseases within the region were monitored, mapped, and assessed for damage impact, and the results were summarized in an Information Report. Areas of moderate-to-severe defoliation were caused by the spruce budworm (106 500 ha), jack pine budworm (2 175 000 ha), and forest tent caterpillar (2 313 000 ha); the mountain pine beetle (MPB) killed over 160 000 pines.

Over 2000 inquiries were processed for insect and disease identification and control under the extension program. Information on tree pests was distributed to various agencies and the public via displays (including the Open House), pest leaflets, publications, slide presentations, and workshops. Several special surveys and collections were conducted for potentially new forest and nursery problems. Representation and reports were provided to various provincial, regional, and national advisory committees and meetings. Ten permanent plots were established across the region as part of ARNEWS (Acid Rain National Early Warning System) for long-term monitoring of acid rain effects on plant foliage and soils. Functional guidance was provided to insect and disease survey staff in Manitoba under the Canada-Manitoba Forest Renewal Agreement, and insect and disease projects were prepared under the Canada-Alberta and Canada-Saskatchewan forest resource development agreements.

Field studies were continued in cooperation with the University of Calgary and Alberta Forest Service on the application of pheromones (behavior-modifying chemicals) for detection, monitoring, and control of MPB, spruce beetle, and spruce budworm. Input was provided to the MPB Interagency Committee and the CANUSA MPB Action Plan, including the field testing of MPB hazard rating systems.

Cooperative studies with the University of Alberta and Alberta Forest Service were conducted toward development of native pines resistant to western gall rust. The role of bark beetle-associated fungi was examined for effects on water conduction in infested trees, and various metabolites of these fungi were bioassayed to detect any pathotoxicity properties. A first draft of a publication on common tree and shrub diseases is nearing completion. Studies on Armillaria root rot fungi were completed, and reports were prepared.

Studies were conducted on specific bacteria, fungi, and yeast organisms influencing ice nucleation in conifer seedlings (i.e., ice-nucleating agents, or INA). Several non-INA strains and species of microorganisms and amino acids were identified, some of which provided control of the INA storage microorganisms.

One Information Report, four journal articles, and three other technical reports were published. Eight technical papers were presented at scientific meetings, and numerous unpublished reports were prepared.

1986–87 objectives: To survey, map, and report on major forest pest infestations such as the mountain pine beetle, spruce beetle, forest tent caterpillar, and spruce and jack pine budworms; to monitor other noteworthy forest pests; to provide diagnostic and advisory services; to modify and develop appraisal methods for estimating current losses caused by major pests; to conduct research on selected forest pests, including tree rusts, mountain pine beetle, and sawflies; to monitor and maintain established plots for acid rain damage; to participate in the preparation of the pictorial guides to forest and shade tree insects and diseases.

Studies:

Forest insect and disease survey
Sawfly systematics
Biological assessment of insects injurious to trees and shrubs
Forest insects: diagnostic and taxonomic services
Damage appraisal of major forest pests
Forest tree rusts of western North America
Forest diseases: research and technical transfer services
Effects of ice-nucleating agents on canker, dieback, and mortality of juvenile forest trees and amenity species

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Project leader:	Professionals:	Technicians:
Dr. B.H. Moody	P.A. Amirault	F.J. Emond
	(From July 1985)	H.S. Gates
	Dr. H.F. Cerezke	P.J. Maruyama
	Dr. Y. Hiratsuka	G.N. Still
	Dr. H.R. Wong	D.L. Szlabey
	H. Zalasky	R.C. Tidsbury

NOR-28

Wetlands, climate, and ENFOR

Objectives: To determine the ecology of peatland development within the region; to develop guidelines for peatland management and rehabilitation; to improve the yields of forests through the drainage of waterlogged forest soils; to evaluate the effects of drainage on the hydrology of drained wetlands and of adjacent undrained areas; to assess the impacts of climate on forest vegetation, especially those associated with forest clear-cut areas; to determine the effect of short-term and long-term climatic fluctuations on forest biomass growth and productivity; to develop and test biomass prediction equations for regional tree species and lesser vegetation and demonstrate their integration with resource inventory programs; to investigate the impact of biomass removal on site quality, nutrient status, silvicultural option, and long-term site productivity; to determine production and delivery costs of biomass under various operating conditions in order to evaluate the use of biomass for energy; to develop and operate a computerized biomass data bank and information retrieval system.

Achievements: Field studies on the ecology of wetland development have been concluded. A total of 252 wetlands have been studied in detail in Alberta, Saskatchewan, and Manitoba. Approximately 6000 peat samples were collected and analyzed for chemical and botanical composition. More than 1000 vascular plants, bryophytes, and lichens were collected and identified. Several journal papers and symposium contributions have been published. In cooperation with the Alberta Forest Service, three wetland sites in Alberta's boreal forest were selected, surveyed, and sampled as experimental drainage areas. Ditch plans were prepared for each, and ditch networks were marked in the field.

A number of publications were produced on climate-forest interactions, including an evaluation of the effects of climate on tree growth, trends in annual and seasonal temperature and precipitation, effects of clear-cutting on local climate, and identification of climatic trends from tree ring studies.

In connection with the ENFOR (ENergy from the FORest) program, 20 contracts were let to various consulting firms, progress was supervised, and the resulting reports were published. The topics included biomass volume and yield tables, growth models for various species, fuel characteristics of various species, novel harvesting methods for forest biomass, and tree ring analyses.

1986–87 objectives: To produce reports on the ecology of wetland development in the Western and Northern Region; to construct drainage ditch systems on two of the three experimental areas and to monitor changes resulting from these treatments; to prepare a report containing a review of forest land drainage projects in Alberta; to prepare reports on various aspects of climate and dendrochronology, short-term climatic variations in the boreal forest, and effects of forest cover on climate; to oversee the conclusion of ENFOR contract studies and adapt ENFOR reports for publication.

Studies:

Peatland development and ecology
Increasing wood production through forest land drainage
Impact of climatic variation on boreal forest biomass
Development of integrated biomass prediction equations for the Western and Northern Region
An assessment of the energy potential of forest biomass in the prairie provinces and Northwest Territories

---

Project leader:	**Professionals:**	**Technicians:**
S.C. Zoltai	Dr. G.R. Hillman	M.W. Ali
	J.D. Johnson	E.B. Robson
	Dr. T. Singh	N.B. Schultz

Forest Resources Research

NOR-4

Stand productivity and forest inventory

Objectives: To develop and assess silvicultural treatments and options for increasing the yields of managed stands and to evaluate them in economic terms; to provide forest management agencies with improved techniques and models for growth and yield prediction for the commercially important cover types and for management options in the prairie provinces and Northwest Territories; to evaluate, develop, and apply new remote sensing and interpretation techniques for forest inventories and environmental management purposes; to provide advisory services on survey design, interpretation methods, and analyses.

Achievements: Numerous long-term growth and yield studies have been initiated in the past to obtain information on intensive forest management treatments and to develop guidelines and prescriptions for treatments such as spacing, thinning, and fertilization of lodgepole pine, jack pine, white spruce, and trembling aspen in the region; the results are being published as they become available. As need arises, intensive short-term studies are conducted to provide information and solutions for specific problems (e.g., stocking standards, juvenile tree growth, and the effect of line opening on tree and stand growth).

An experimental Geographic Information System was developed to produce digital forest inventory map data bases and to convert these to a biomass inventory and maps; a computerized large-scale photo sampling and interpretation system has been designed, developed, and tested; manual and digital image analysis interpretation techniques for satellite imagery have been developed, and these have been applied in cooperation with provincial agencies and under the ENFOR and Environment 2000 programs.

During 1985–86 two journal papers were published on pest damage incidence in natural and thinned lodgepole pine in Alberta. Further work is in progress to quantify the impact on tree growth of leader-damaging insects and various diseases (primarily western gall rust).

The use of STEMS (Stand and Tree Evaluation and Modeling System) for growth and yield prediction of thinned and unthinned white spruce plantations was demonstrated at a foresters' field tour in Manitoba, and a presentation on its use was made at the fall meeting of the local Canadian Institute of Forestry.

The establishment phase of a new study to assess the effect of fertilizing in combination with thinning semimature lodgepole pine was completed. This included soil and vegetation sampling, fertilizer application, and preparation of an establishment report.

A new study was started on stand tending techniques in the mixedwood forest, relying on data from earlier studies established in the region as far back as 50 years ago. The purpose is to prepare silvicultural prescriptions for releasing white spruce from trembling aspen competition and to assess the impact of such treatment in terms of increases in white spruce timber production.

A new study was also established for economic evaluation of intensive forest management practices such as spacing, thinning, and fertilization. An analysis of economic returns from fertilizing 70- and 30-year-old lodgepole pine was completed.

Activities in remote sensing for forest inventory have included presentations on change monitoring using satellite imagery and preparation of three reports. In large-scale photography, a study (M.F. thesis) was completed on the use of simulated thematic mapper data for forest classification; a seminar presentation was made on choosing between 240-mm and 70-mm camera formats for forestry; and talks were given on satellite remote sensing. In addition, an operational camera system for the Yukon Territory's Northern Affairs Program was nearly completed, and a cooperative photomensuration project on crown area and tree height measurements for diameter estimation was initiated with the Alberta Forest Service and Silvacom Limited.

1986–87 objectives: To prepare guides for spacing lodgepole pine and using STEMS; to contribute to analyses of research and development needs in stand tending, growth, and yield for Saskatchewan and Alberta in relation to the forestry development agreements and memorandums of understanding and to help organize a workshop on stand tending of jack pine in Manitoba; to present three papers at international symposiums on the impact on tree growth of stem diseases, shoot boring insects, and red belt injury in lodgepole pine stands; to prepare reports on thinning black spruce and jack pine in Duck Mountain, improving productivity of preharvest lodgepole pine by fertilization, and spacing effects in lodgepole pine in Alberta and in three conifers in Manitoba; to prepare journal articles on N, S, and P ratios in 40-year-old lodgepole pine to detect and correct nutrient imbalances; to finalize a report on the economic returns from fertilizing 70- and 30-year-old lodgepole pine; to complete analysis and prepare a report on white spruce tree and stand growth after release from aspen and to assess growth and yield of white spruce-trembling aspen stands in relation to species mix and other variables; to prepare an ENFOR report on a mapping and analysis of resources system application; to prepare a journal article on mapping of burned forest land in the Northwest Territories; to continue large-scale photography operational trials in Alberta and the Yukon; to prepare a journal paper on the thematic mapper and a report on Alberta forest fire history maps, 1931–83; to initiate a large-scale photography project for regeneration assessments in cooperation with PAPCO and the Saskatchewan Department of Parks and Renewable Resources under the Canada-Saskatchewan Agreement.

Studies:

Growth and yield of five commercially important native species in Alberta, Saskatchewan, and Manitoba

Stand modeling of the growth and development of important forest types

Transformation and movement of applied fertilizer elements (N, P, and S) in selected lodgepole pine stands

Fertilization of established lodgepole pine stands

Fertilization and thinning of semimature lodgepole pine stands

Forest inventory

Development and application of large-scale photo and image analysis techniques to forest inventories

Project leader:	Professionals:	Technicians:
Dr. I.E. Bella	Dr. J. Baker	S.J. Lux
	H.S. Grewal	T.J. Walsh
	R.J. Hall	
	W.C. Moore	
	W.J. Ondro	
	(Transferred from NOR-3 in Sept. 1985)	
	Dr. R.C. Yang	

NOR-10

Regeneration and plantation management

Objectives: To promote the development and dissemination of silvicultural knowledge and its application, particularly to forest regeneration and plantation management by maintaining effective consultation and liaison with resource managers and other researchers regionally and across Canada and by undertaking silviculture research and development in the areas of ecological site classification and site productivity, effects of mechanical site treatment on soil properties and seeding and planting chance and subsequent plantation development, field performance of stock and guidelines for their use, causes of early mortality in pine plantations, and effects and costs of various vegetation management techniques aimed at improving establishment and growth of new forest crops.

Achievements: During 1985, project work focused mainly on research and technology transfer in the area of mechanization of silviculture, soil amelioration, vegetation management, forest ecology and site productivity, field performance of planted stock and causes of early mortality in lodgepole pine and jack pine.

Work with mechanization of silviculture and soil amelioration included investigations into the potential use of subsoilers and deep tillage techniques to improve forest soil conditions, continuation of a regional silviculture equipment inventory, and field assessment of silviculture equipment performance, particularly site preparation equipment. The national CFS silviculture equipment inventory is now available at NoFC. Technology transfer continued through membership in the National Committee for Mechanization of Silviculture (NACMEC) and through organization and chairmanship of the National CFS Committee on Site Classification and Land Evaluation (SCALE).

A new vegetation management project involving researchers from three NoFC projects and staff of the Research and the Reforestation and Reclamation branches of the Alberta Forest Service has been initiated under the Canada-Alberta Forest Resource Development Agreement and is being coordinated by NOR-10. This project will test silvicultural, environmental, and economic aspects of manual, mechanical, and chemical treatments for the purpose of site preparation and conifer release. Monitoring of previously established herbicide efficacy and crop tolerance studies in Alberta and Manitoba has continued, and a summary report of 5-year results has been prepared. There was continuing support for involvement in the executive of the Expert Committee on Weeds, Silviculture Section (western), technology transfer through field tours to herbicide plots in Alberta, and continued contact with the Forest Pest Management Institute in Sault Ste. Marie, Ontario, regarding herbicide vegetation status and related field plots in this region.

Technology transfer in silviculture research and development continued through chairmanship of the Regional Reforestation Technical Committee (RRTC) and through publication of silviculture statistics under the Canada Forest Resource Data Program (CFRDP).

Work in forest ecology and site productivity included completion of an ecological classification field guide to forest ecosystems of west-central Alberta. Field sampling was completed in Saskatchewan and Manitoba for a study of factors contributing to high-production sites. Papers were presented at symposiums on the subjects of the effects of soil compaction during logging and site preparation upon seedling growth, ecological classification for forest management, and site classification methodology in the region.

Field measurements of the performance of planted stock in a cooperative study with the Alberta Forest Service at Grande Prairie, Alberta, continued. This is a comprehensive test of container size, soil type, and season of planting for both white spruce and lodgepole pine. Three-year results are now available for all tests, and 5-year results will be available in 1987 for the entire project.

Assessment of the effects of climatic factors, insects, disease, and rodents upon the survival and growth of lodgepole pine and jack pine up to 35 years of age continued, with third-year data collected on jack pine in Manitoba and fourth-year data collected on lodgepole pine in Alberta. A pictorial guide to the forest and shade tree insects of the prairie provinces is under review and will be a major contribution to technology transfer in this field. The book is being prepared in collaboration with the Forest Insect and Disease Surveys and Management Systems project at NoFC.

Silviculture research and technology transfer in Manitoba included assessment of candidate areas for vegetation management research and preparation of reports based on remeasurement of previously established CFS projects related to herbicides, field performance of planting stock, fertilization, and other silviculture treatments. Some projects were accessed for use as demonstration areas under the Canada-Manitoba Forest Renewal Agreement. There was extensive contact with both governmental and nongovernmental forestry staff in Manitoba, and a variety of technology transfer activities were carried out, including displays during National Forest Week and at exhibitions.

1986–87 objectives: To maintain regional research, development, and technology transfer activities in inventory and evaluation of equipment used in silviculture, vegetation management, field performance, and development of plantations, ecological classification, site productivity, and cumulative mortality studies on pine; to cooperate with national groups such as the National Committee for the Mechanization of Silviculture, the Forest Pest Management Institute, the Canadian Forest Resource Data Program, and the Expert Committee on Weeds; to participate in international symposiums sponsored by agencies such as IUFRO (International Union of Forestry Research Organizations).

Studies:

Silvicultural investigations
Chemical control of pests and vegetation in managed forests

Silviculture research and technology transfer—Manitoba
Forest ecology and site productivity
Evaluation of mortality in stands of young trees in plantations and scarified areas
Vegetation management techniques for forestry
Soil amelioration in boreal forests

Project leader:	Professionals:	Technicians:
L.G. Brace	Dr. I.G.W. Corns	D.T. Allan
	W.D. Holland	J.A. Drouin
	W.G.H. Ives	J.R. Gorman
		C.L. Rentz

NOR-12

Nursery management and tree improvement

Objectives: To formulate planning tools and guidelines for promoting improved standards of management of regional forest nurseries, particularly in the areas of bare-root and containerized seedling production, handling, storage, seed and seedling physiology, and cold tolerance; to produce genetically improved grafts, seeds, seedlings, and rooted cuttings of jack pine in sufficient quantity to facilitate mass production by regional cooperators; to continually increase the degree of genetic improvement in jack pine and contribute knowledge on genetic variation in forest tree species.

Achievements: Studies in overwintering physiology of lodgepole pine, jack pine, red pine, white spruce, and black spruce continued. Freezing tolerance and survival tests using oscilloscope-square wave deformation (SWD) and electrical conductivity and dormancy tests using oscilloscope-SWD, root growth capacity (RGC), time to bud break, and mitotic index were conducted. The overwintering physiological state of the seedlings was monitored reliably by RGC and electrical conductivity. A presentation on this work was made at a meeting in Providence, Rhode Island. Study of the role of selected endogenous cellular metabolites, (e.g., abscissic acid and auxins) in cold hardening and dormancy was continued; sample preparation through freezing and lyophilizing was emphasized. Chromatographic methods of analyzing cellular metabolites with NoFC equipment were evaluated. Accelerated growth and promotion of flowering studies incorporating hormone, supplemental light, and photoperiod treatments were continued. A presentation on this work was made at an international meeting in Heidelberg, West Germany.

Advisory services and technology transfer were provided to nurseries throughout the region. Problems concerning peat quality, establishment of seedlings, and aluminum toxicity in Manitoba, snow blight in Saskatchewan, and premature bud set and use of herbicides on containerized seedlings in Alberta were addressed. The monitoring program for soil fertility and seedling nutrition in bare-root nurseries was continued; soil and foliage were analyzed, and recommendations were provided. A study designed to establish size class standards and develop methods of monitoring stock quality was initiated in Saskatchewan. An investigation of seed quality through X-ray and germination tests was conducted on Saskatchewan seed lots. A study was continued on residual fertility in jack pine and white spruce seedbeds at Prince Albert. Physical and chemical characterization of soil from an extension of the PAPCO seed orchard in Henribourg, Saskatchewan, was completed. Presentations on fertilizing bare-root and containerized conifer seedlings were made at meetings in Fort Collins, Colorado, and Fredericton, New Brunswick, respectively.

The 10-year measurement of black spruce test plantations in Manitoba and the central breeding district family test in Manitoba and Saskatchewan were completed. Cones have been harvested from the mass selection seed orchard at Oakbank, Manitoba, to perform a yield test. Functional guidance was provided for development of jack pine seed orchards under the Canada-Manitoba Forest Renewal Agreement. Tree improvement technology in the region was

promoted by providing scions of selected jack pine families for a study on genetics of western gall rust. Over 300 grafts were planted in the clone bank at Chip Lake, Alberta. Grafts in pots or lined out at NoFC were tended, and understocks for 1986 were reared. Record management of stocking of the clone bank has improved because of a refined computerized system.

1986–87 objectives: To maintain a monitoring program in soil fertility and seedling nutrition in bare-root nurseries and investigate seedling growth problems; to continue the study on the establishment of size class standards for monitoring stock quality; to continue research into dormancy and cold hardiness and the role of endogenous cellular metabolites in tree seedling physiology; to complete research on the effects of residual soil fertility on succeeding crops of bare-root seedlings; to review the status of all provenance studies and prepare an evaluation report; to increase clone bank stocking with grafts and maintain an inventory of further graft requirements; to provide functional guidance for development of jack pine seed orchards in Manitoba under the Canada-Manitoba Forest Renewal Agreement.

Studies:

Forest tree seed and seedling physiology
Provenance tests for coniferous species
Breeding jack pine for the northern region. I. First selection cycle
Forest nursery research and technology transfer
NoFC greenhouse and nursery operations
Nursery soil fertility and seedling growth

Project leader:
Dr. I.K. Edwards

Professionals:
Dr. I.J. Dymock
E.M. Harvey
Dr. J.I. Klein

Technicians:
P.B. Chapman
(From July 1985)
F.M. Dendwick
W.M. Mills
J.J. van Dyk

Forestry Extension

NOR-5

Fire management systems and guidelines

Objectives: To provide guidelines and standards to resource managers that will reduce, at an acceptable cost, the damages and losses from forest fires while considering the related economic, ecological, environmental, and social factors; to develop fire behavior guides for regional fuel types and integrate them with the Canadian Fire Weather Index (CFWI); to elucidate the natural role of fire and describe fire effects on forest ecosystems; to provide precise information on air tanker performance, fire retardant performance and effectiveness, retardant drop patterns, improved fire-line productivity, and fire detection systems and methodology; to develop, test, and promote the application of models simulating various suppression activities at the field operational level and directed toward improved utilization and effectiveness of funds, manpower, and equipment.

Achievements: Several papers on jack pine and fire were published, and others are in preparation. Additional lightning fire origin data were collected. Studies were conducted in cooperation with the Alberta Forest Service (AFS), Canadian Interagency Forest Fire Centre, Conair, and the National Safety Council of Australia to evaluate the Daedalus infrared line scanner as a detection tool. A fire data base for Wood Buffalo National Park was prepared along with a program to utilize these data. In conjunction with the Western and Northern Region Fire Weather Data Library, two utility computer programs, HISTO and a consistency check program, were produced. A problem analysis and multiyear research plan were prepared for operations research in forest fire management. Seven microcomputer programs were developed for computers such as the IBM PC, Apple III, and Wang. Scientists conducted a series of six successful experimental burns and related fieldwork in cooperation with the Alberta Forest Service at the Big Fish Lake site.

Presentations were made on the fire research program at several meetings throughout the region. Several meetings were held with provincial fire personnel in Manitoba and Saskatchewan regarding forest development agreement efforts. Two meetings of the CFS Fire Danger Working Group were attended, and contributions were made to the preparation of an interim edition of the Canadian Forest Fire Behavior Prediction System. Papers were presented at several national and international meetings, including the Eighth Conference on Fire and Forest Meteorology, workshops, training sessions at Hinton, Alberta, and other gatherings such as a Fire Management Workshop, an Advanced Fire Behavior Course, and meetings of the Kelsey Institute, Western Fire Weather Committee, AFS Rangers, Alberta provincial parks management, and Central Region Fire Weather Committee. English and French versions of a bibliography on the Canadian Forest Fire Danger Rating System were prepared. Several meetings, seminars, and symposiums were sponsored, organized, cohosted, and chaired. A forest fire growth calculator was developed.

1986–87 objectives: To conclude several papers on jack pine and fire for Alberta and Saskatchewan studies; to publish thesis results on forest fuels in Jasper National Park; to continue comparative evaluation of retardants and collect additional lightning fire origin data; to

finalize a regional fire research strategy and conduct a regional fire research technical subcommittee meeting; to prepare an annotated bibliography of CFS fire research in the prairie provinces and NWT; to finalize a fire history atlas of Alberta; to continue experimental burns at the Big Fish Lake site.

Studies:

Fire behavior in boreal forest fuels
Evaluation and development of fire detection-suppression technology
Evaluation of the role of fire in forest and intermingled vegetation in the prairie provinces, Rocky Mountains, and far north
Decision-aid models for use in fire management
Fire danger and behavior rating in forest and rangeland environments

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Project leader:
Dr. R.J. Barney
(From July 1985)

Professionals:
M.E. Alexander
Z. Chrosciewicz
G.P. Delisle
B.S. Lee
R.S. McAlpine
W. Vanderschuit
(From Oct. 1985)

Technicians:
E. Kuyt
M.E. Maffey
C.J. Ogilvie
R.M. Smith

NOR-13

Forest hydrology and microclimate research

Objectives: To provide forest management techniques to improve water yield from Alberta's Eastern Slopes forests; to investigate and evaluate the effects of traditional and nonstandard forest clearing practices on soil moisture and microclimate as they affect regeneration, establishment, production of fiber, and rotation duration; to evaluate the effects of events such as insect and disease damage, forest fires, and forest clearing activities on local water yield, regime, and quality.

Achievements: Three subbasins (Cabin, Middle, and Twin) of the Marmot Creek experimental watershed in the Kananaskis River valley in Alberta have been calibrated. A commercial harvest of the Cabin subbasin did not increase sediment in the stream but did increase annual streamflow by about 30 mm. Over 2000 circular openings, one tree-height in diameter, were cleared on the Twin subbasin. These clearings contain about twice as much snow at peak accumulation as the uncleared areas between them. Streamflow from the Twin subbasin is being evaluated against that of the Middle subbasin, which has not been harvested. The Marmot Experimental Watershed Program is to be terminated in October 1986.

A U.S. Forest Service procedure for predicting the effects of forest harvesting activities on annual streamflow has been adapted for use in Alberta. Routines have been added to allow estimation of the effect of wind on snow loss. The procedure predicts the annual yield of ungauged catchments within 10% of actual.

1986–87 objectives: To provide forest managers with practical management prescriptions and guidelines that will stabilize or improve the quantity, quality, and delivery time of water from forested areas; to investigate and evaluate the effects of traditional and nonstandard forest clearing practices on microclimate and soil moisture as they affect regeneration, establishment production, and rotation duration; to finalize and have published a major report on the hydrological effects of clear-cutting at Marmot Creek and Streeter watersheds.

Studies:

Research coordination in the Alberta Watershed Research Program on Marmot, Streeter, Tri Creeks, and Spring Creek experimental basins
Vegetation manipulation-disposition of snow in forest clearings

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Project leader:	Professionals:	Technicians:
Dr. R.H. Swanson	Dr. P.Y. Bernier	Z. Fiera
		P.A. Hurdle

NOR-33

Technology transfer and information

Objectives: To coordinate and promote the planning and delivery of an effective technology transfer program in the Western and Northern Region; to provide relevant and timely information to NoFC user clientele (scientific, technical, and public) at a reasonable cost, using a variety of communications techniques (publications, personal contact, audio-visual presentations) and other available information; to provide scientific and technical editing and publishing services; to provide a full range of library and photographic support services to NoFC personnel.

Achievements: Created in 1984, this project amalgamated a newly created technology transfer study, an enhanced public information program, an established scientific and technical editing and publishing program, and ongoing library and photographic services.

In 1985–86 an increased effort was put into public awareness and information activities. Open House '85, in recognition of the 15th anniversary of NoFC, was held in May during National Forest Week. Through a concerted effort of presenting displays at major exhibitions throughout the prairie provinces, the targetted number of 50,000 public contacts was achieved. In addition to National Forest Week activities, displays were set up at the Red River Exhibition in Winnipeg, Calgary Stampede, Buffalo Days Exhibition in Regina, Prince Albert Exhibition, and Pioneer Days Exhibition in Saskatoon. A number of other minor shows and exhibits rounded out the year's public information activities.

Communications subprograms developed for the three federal-provincial forestry development agreements were implemented by NoFC and district office personnel. Additional activities included preparation of news releases, coordination of three Ministerial visits to the region, and design and fabrication of two new portable exhibits.

In 1985–86, 9 Information Reports, 1 Forest Management Note, 2 Pest Leaflets, a Program Review 1984–85, and 42 journal articles and miscellaneous publications were produced. Two publications (Information Report NOR-X-262, *Decay of aspen and balsam poplar in Alberta*, and the NoFC information brochure) received Awards of Excellence from the Society for Technical Communication, Eastern Ontario Chapter.

The library continued to offer the full range of services, and the photographic section operated at full capacity with the addition of a term photographic assistant. The capabilities of the photo section have been greatly increased by the acquisition of new color print processing equipment, an advanced technology enlarger, and a copy camera.

1986–87 objectives: To maintain the established levels of public information and technology transfer activities; to continue to implement communications subprogram activities under the three federal-provincial forest resource development agreements; to assist staff in the preparation, publication, and distribution of scientific, technical, and public information; to provide a full range of library and photographic support services.

Studies:

Scientific and technical editing and publishing
Technology transfer and public information
Library
Photography

Project leader:
R.G. Newstead

Professionals:
A.C. Ascher
(From Dec. 1985)
B.J. Boughton
(From Dec. 1985)
A.M. Keeling
(Resigned Oct. 1985)
D.J.S. Robinson
J.K. Samoil
G.B. Turtle
(Resigned Sept. 1985)

Technicians:
D.J. Adams
J.H. Baker
P.S. Debnam
E.M. Hopp
D.D. Lee
S.S. Phillips
H.M. Stewart

NOR-53

Computing and data processing services

Objectives: To provide computing and computing-related services, office automation advice, telecommunications advice, financial system assistance, mapping and statistical service and assistance, computer education, networking, and computer capital coordination.

Achievements: The form of the services varies from writing computer programs for the VAX 11/750, HP1000, and a variety of personal computers to plotting on the laser printer and TEKTRONIX, providing data-base management systems, advising on the selection of computing equipment for individuals and data center use, providing statistical advice and program assistance, helping students during the summer who are working with other sections, and providing elementary and intermediate computer use and programming courses.

Since the VAX 11/750 was installed, usage has increased by a factor of three. Version 4.3 of the operating system was installed and is working, and 4 megabytes of memory have been installed, to bring the VAX up to three-quarter capacity. New versions of other software are also in place. Several terminals were received and have filled up the local area network; an upgrade will be installed to allow use of more lines. The BMDP and SAS statistical packages have been ordered. The district offices have received letter-quality printers, terminals, and modems, and the Prince Albert office will get a stand-alone DECMATE word processor (this will interact with the VAX as well for file transfers). Software has been installed to transfer files to and from the AES word processor and the VAX, and upgrades have been installed for the AES system and AM Varityper phototypesetter. A word processing package has been added to the VAX that will allow word processing on any VT100-type terminal and is compatible with the DECMATEs that have been assigned to the directors' secretaries. A noticeable increase in the number of users on the VAX has occurred since September, and service bureau usage has dropped. Over the year this will add up to several thousand dollars in savings, money that would have been paid to the service bureau. We have a computer terminal on at least each project leader's desk as part of the overall office automation strategy. Several courses were given to get new users on line. The new Olivetti personal computers have been installed for the financial system, which in turn will use new software being developed by CFS for use with the FINCON system and the VAX—there is one in each of the district offices and two at NoFC.

1986–87 objectives: To continue to supply and expand computing and data processing services to fill the needs of NoFC and the district offices; to assist with the DEVMIS programs for management of the forest resource development agreements; to provide services as required in all aspects of office automation, communications, computing equipment selection, computing education, and other computer-related fields.

Study:

Computing and data processing services

Project leader:	**Professionals:**	**Technician**
W. Chow	A.W. Irwin	L. Hai
	A. Paradis	
	(From Oct. 1985)	
	T. Tan	
	(Resigned July 1985)	

Regional Development

NOR-3

Forest resource economics and statistics

Objectives: To provide socioeconomic information to regional forestry programs for rational policy formulation and program development by identifying and estimating the major economic benefits, product flows, and impacts of the forest resource and its utilization in the Western and Northern Region; to provide input to regional forestry programs by participating in interdisciplinary studies; to provide economic statistics and guidelines on costs and benefits of the forest resource, impacts of forest management, marketing, and related socioeconomic data; to collect and interpret forestry statistics at the regional and national levels in order to provide advice and guidelines to resource managers and researchers in support of forest policy decision making.

Achievements: A number of key papers were published by NOR-3 staff: "Costs and benefits of precommercial thinning: an overview and case study," which was presented at the IUFRO (International Union of Forestry Research Organizations) conference in Moscow, USSR, a journal article on factor substitution and economies of scale in the Alberta sawmill industry, and an Information Report entitled *The forest industry in the economy of Saskatchewan, 1979–80*. In addition, a report on the forest industry in the Northwest Territories is in final preparation, and a comprehensive forest economics research program was developed for the province of Saskatchewan and a number of projects initiated. Various interdisciplinary research projects were begun, including those on the economics of thinning, wildfire management, and vegetation management. Numerous discussions were held toward developing and implementing a framework for evaluating the federal-provincial forest resource development agreements in Manitoba and Saskatchewan.

1986–87 objectives: To assist in the development and implementation of various interdisciplinary forest economic and silvicultural studies to provide operational guidelines for cost-effective use of funds in intensive and extensive forest management; to participate in evaluation programs in Manitoba and Saskatchewan; to provide socioeconomic and statistical data, analysis, and documentation for policy and program development; to continue to provide input to the Canadian Forest Resource Data Program (national inventory and permanent sample plots); to prepare a landmark 10-year silviculture statistics information report.

An Information Report entitled *Silviculture statistics for Canada, 1975–76 to 1982–83*, was published and was distributed at the National Forestry Forum. Work was initiated on the development and implementation of the 1986 national forest inventory.

Work continued on cataloguing and conversion of selected NoFC permanent sample plots (PSP) for inclusion in the national PSP inventory.

Studies:

Socioeconomic and statistical analyses of forest management practices and of development opportunities for forest-based economics in the prairie provinces and Northwest Territories

Forestry and socioeconomic statistics and analysis/DEVMIS
Interdisciplinary studies in forestry research

Project leader:
D.M. Boylen

Professionals:
J.P. De Franceschi
D.H. Kuhnke
A.M. Mauch
(From July 1985)
T.B. Williamson

Technician:
R.A. Bohning

NOR-36

Development agreements

Objectives: To implement federal-provincial forestry development agreements in Alberta, Saskatchewan, and Manitoba; to assess the impact of regional, national, and international economic and social events on regional development of the forestry sector; to develop and implement forestry-related job creation programs in the prairie provinces and Northwest Territories; to assist in the development of other forestry-related federal initiatives, as required.

NOR-36-01

Canada-Manitoba Forest Renewal Agreement (Manitoba District Office)

Achievements: New district office facilities in Winnipeg were opened by the Hon. Gerald Merrithew, Minister of State (Forestry), in September 1985. The Manitoba District Office has 15 staff members with expertise in the areas of damage appraisal, silviculture operations and research, fire research, forest economics, and tree improvement. Manitoba District Office personnel are primarily involved in activities under the Canada-Manitoba Forest Renewal Agreement, but they also carry out many other activities, including extension and advisory services to industry and the public, job development program promotion and delivery, and public education.

Public information activities included a public awareness survey and the production of numerous booklets and brochures to increase public interest and highlight forestry activities in Manitoba.

Under the Canada-Manitoba Forest Renewal Agreement, the two major forest companies—Abitibi-Price and Manfor—carried out a variety of reforestation and intensive management activities, including mechanical site preparation, planting, and stand tending. A contract was also let for reforestation work on the Moose Lake Reserve.

Capital expansion of facilities at the two provincial nurseries continued with the construction of a new seeding line building at the Clearwater Nursery, The Pas, and construction of a new tree improvement research facility at the Pineland Nursery, Hadashville. The new tree improvement facility will be put into operation in 1986–87 and will provide material for outplanting into two new jack pine seed orchards.

Insect and disease investigations addressed damage appraisal in jack pine budworm infested stands; over 210 sample plots were established throughout the province. Data from this survey will be used to design an efficient damage appraisal survey program compatible with the forest inventory system in Manitoba. The Geographic Information System, purchased in

1984–85, was installed in the Manitoba Forestry Branch offices, and staff training and initial data loading commenced. Fire research activities concentrated on fire weather and fire report data compilation and analysis.

A review of research plots established between 1904 and 1970 was carried out, and numerous plots were identified as having potential for development as demonstration areas. The resulting data will be put in a machine-readable form.

1986–87 objectives: To manage and report on activities funded under the Canada-Manitoba Forest Renewal Agreement; to consult, liaise, review, monitor, and report on activities funded with federal funds under the cost-shared programs of the Canada-Manitoba Forest Renewal Agreement; to review the technical aspects of the federal forestry-related job creation programs; to ensure the development of an agreement evaluation process; to develop jack pine seed orchards and transfer these to the province; to carry out an investigation of site classification needs and make recommendations for implementation of a suitable system in the province; to organize and contribute to a nursery management workshop focusing on current tree nursery problems; to provide a program of economic research, including an analysis of the primary wood-using industry and advisory services.

Studies:

Forest pest management and damage appraisal
Yields of managed stands:
1. Establishment of stand tending and regeneration demonstrations
2. Releasing white spruce from trembling aspen

Fire management
Regeneration:
1. Guidelines for the management of white and black spruce
2. Hare damage assessment and technology transfer

Establishment of jack pine seed orchards
Forest site classification
Forest nurseries
Forest economics
Forest inventory
Tree improvement

NOR-36-02

Canada-Alberta Forest Resource Development Agreement and development program coordination (Northern Forestry Centre)

Achievements: Standards and procedures were developed for the Canada-Alberta Forest Resource Development Agreement through Agriculture Canada, Systems and Consulting Directorate.

Public information activities included the development of a 5-year public information plan, the production of a brochure to solicit proposals from the private sector, the preparation of a mobile forestry exhibit trailer to promote forestry awareness and education, and the completion of a public awareness survey.

Forest research activities were numerous. Among the projects initiated were a cooperative vegetation management project to assess the silvicultural effects of selected methods of site preparation and crop release treatments for softwoods, a major cooperative wetland drainage project to develop optimal silvicultural regimes for increasing the growth of commercial tree species on drained wetlands, insect and disease investigations to identify when and where damage by forest pests may occur, and the development of an economic timber supply model for Alberta. Work also commenced on the cataloging of all NoFC permanent sample plot information.

Forest products research in 1985–86 included projects that addressed the prospects for processing aspen using explosion technology, lignin characterization studies, aspen kiln drying schedules, use of spruce and pine in laminated beam construction, and a survey to assess Alberta forest industry research needs.

Reforestation and growth enhancement activities involved a sanitation cutting program in mountain pine beetle infested stands on the Blood Indian Reserve as well as negotiation with numerous Indian bands for projects to commence in 1986–87.

1986–87 objectives: To review socioeconomic events—regionally, nationally, and internationally—and assess impacts in terms of the Canadian Forestry Service's mandate and programs in relation to regional development in the forestry sector; to develop, implement, and administer projects under various federal forestry-related job creation programs, as required; to coordinate federal economic development activities in the forestry sector with other federal government agencies, provinces, universities, forestry companies, and other interested groups; to establish program delivery capabilities necessary to ensure the successful development, funding, and implementation of projects pursuant to the following forestry agreement objectives within Alberta, Saskatchewan, and Manitoba: a) development and maintenance of timber supplies sufficient to ensure the long-term viability of the forest industry in the prairie provinces; b) efficient utilization of both softwood and hardwood forest resources; and c) economic development and diversification of provincial economies as well as improvement of employment and human resource development opportunities in the forestry sector.

Studies:

Forest vegetation management: silvicultural assessment of selected methods of site preparation and crop release in areas designated for softwood production in Alberta

Forest vegetation management: control of aspen development in areas designated for softwood production in Alberta

Forest vegetation management: environmental impacts and residue chemistry of forestry herbicides

Forest vegetation management: cost-effective strategies for vegetation management in areas designated for softwood production in Alberta.
Tree improvement
Wetland drainage
Forest pest management and damage appraisal
Managed stand yield tables for lodgepole pine and white spruce
Forest economics, statistics, and supply modeling
Canada-Alberta public information subprogram

NOR-36-03

Canada-Saskatchewan Forest Resource Development Agreement (Saskatchewan District Office)

Achievements: New district office facilities in Prince Albert were officially opened by the Hon. Gerald Merrithew during National Forest Week in May 1985. This was one of the many events that took place in Prince Albert, which was the 1985 Forestry Capital of Canada. The 12 CFS personnel now located in Prince Albert have expertise in silviculture operations and research, forest protection (including fire and entomology), and forest economics. Future staffing will result in the addition of expertise in forest mensuration and growth and yield. Many of the activities are related to the Canada-Saskatchewan Forest Resource Development Agreement; however, district office personnel are also involved in other activities, including job development program promotion and delivery, extension services to industrial clients, development and advisory services to the public, delivery of projects under the ENFOR (ENergy from the FORest) program, and public education.

A multiyear forest research plan was completed in 1985–86 and was approved by the agreement directorate. This comprehensive plan forms the basis for cooperative research studies during the term of the agreement.

Approximately 15 project authorization forms totalling over $2 million were processed to varying stages of federal-provincial review and commitment or expenditure of funds under the forest renewal, growth enhancement, technology transfer, and administration programs. In addition, the Research Memorandum of Understanding Committee established prior to the agreement has commenced ranking research activities funded through the agreement.

Numerous reforestation and growth enhancement activities were carried out by the province, industrial leaseholders, Indian bands, and private woodlot owners and include mechanical site preparation, planting, regeneration surveys, equipment trials, and management plan development.

Construction commenced on a new packing and refrigerated storage facility at the Big River Forest Nursery as well as new pump houses at both the Big River and Prince Albert Forest nurseries. Construction of these new facilities will be completed in 1986–87.

A review and analysis of 10 years of data related to field performance of white spruce planting stock was initiated in cooperation with the province. A prescribed burn program was also developed as well as an evaluation of the fire weather station network in Saskatchewan.

1986–87 objectives: To manage and report on activities funded under the Canada-Saskatchewan Forest Resource Development Agreement; to consult, liaise, review, monitor, and report on activities funded with federal funds under cost-shared programs of the Canada-Saskatchewan Forest Resource Development Agreement; to consult, liaise, and advise other federal departments or agencies responsible for delivery of federal job development programs related to forestry; to deliver a program of forest mensuration research in Saskatchewan and to provide advisory services and technology transfer; to implement a program of silvicultural investigations through applied research, advisory services, technology transfer, field trials, reports, and surveys; to provide advice on vegetation management through technology transfer, liaison, and provision of advisory services; to provide a program of forestry public information for the CFS, including press tours, ceremonies, feature articles, publications, press releases, and public relations; to carry out pest management and damage appraisal activities and provide advisory services through technology transfer.

Studies:

Forest mensuration research
Silviculture investigations
Forest nursery investigations
Fire management
Stem injection of residual aspen
Crop tree and vegetation response to various vegetation control treatments in boreal/mixedwood sites in Saskatchewan
Forestry public information
Insect and disease investigations
Forest economics

Project leader:
H.S. Price

Professionals:
R.M. Coté
(From Sept. 1985)
J. Mrklas

NOR-54

Management of regional development program

Objectives: To plan, implement, and manage a work program designed to meet the forestry development needs of governments, private industry, universities, and other agencies in the prairie provinces and Northwest Territories; to establish and maintain effective working relationships with resource management agencies in the region; to participate in the development of policy and program priorities at regional and national levels; to provide effective managerial, administrative, financial, and other services to the Regional Development Program.

Achievements: In 1982, NoFC assumed responsibility for the development and implementation of federal-provincial agreements in the prairie provinces. The Regional Development Program was established in late 1982.

Discussions and negotiations were initiated with officials of the Manitoba, Saskatchewan, and Alberta governments and resulted in the identification of proposed programs and funding levels for 5-year federal-provincial forestry development agreements with these provinces. A $27 million Canada-Manitoba Forest Renewal Agreement was signed in March 1984, a $28 million Canada-Saskatchewan Forest Resource Development Agreement was signed in June 1984, and a $23 million Canada-Alberta Forest Resource Development Agreement was signed with Alberta in October 1984. In addition, 65 forestry projects for $3.5 million employed 1100 people in 1984–85 under the Environment 2000 Program.

The emphasis in 1985–86 was on gearing up operations and implementing the agreements, which staffed 30 positions, developed over 100 projects, and opened two expanded district offices in Prince Albert and Winnipeg. The job creation program worked with sponsors to develop 48 project proposals worth $8.3 million, of which $4.7 million was recommended and $2.6 million was in operation at year end. Other program areas include economics and forestry statistics. The economics group published four reports and developed an appropriate economics program for the agreements. The FORSTATS program published the national silviculture statistics report and is proceeding to transfer existing sample plot data into machine-readable form in anticipation of the emerging data cooperative.

1986–87 objectives: To operationalize the agreements into federal-provincial delivery systems and anticipated job creation programs; to manage the portfolio under guidelines received from the Canadian Forestry Service's Development Branch, including the projects under the agreements that are functionally directed elsewhere; to continue the development and implementation of employment stimulation programs in the forest sector within existing constraints.

Study:

Program Director, Regional Development

Project leader:
Dr. M.J. Heit

Management Services

NOR-51

Financial, administrative, and support services

Objectives: To provide a system of financial control and accountability in accordance with statutory and regulatory requirements; to provide general administrative support services, including materiel management, records management, engineering, building maintenance, secretarial and office services, and vehicle fleet management.

Achievements: All support units continued to provide a high level of service to the two district offices, opened in Prince Albert and Winnipeg, and to the Centre.

1986–87 objectives: To continue to provide efficient administrative, materiel management, and financial support services.

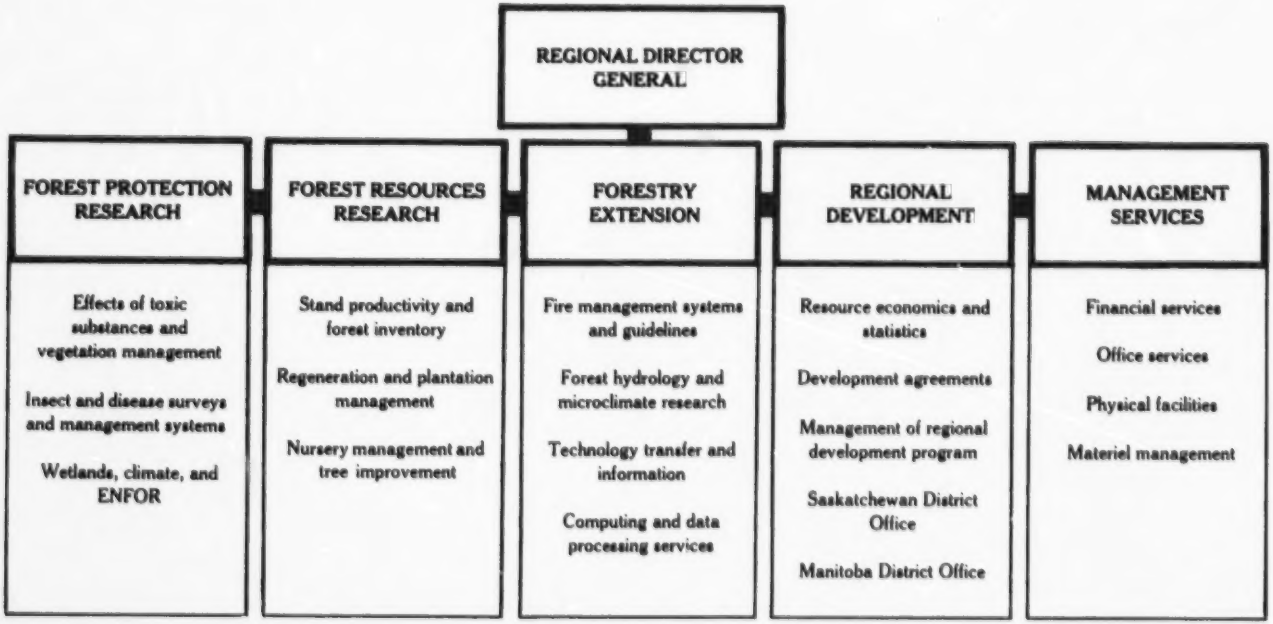
Studies:

Financial services
Administration
Office services
Materiel management
Physical facilities
Electronic services

APPENDIX A

ORGANIZATION CHART

(As of March 31, 1986)



APPENDIX B

STAFF LISTING

(April 1, 1985, to March 31, 1986)

Regional Director General of Forestry: A.D. Kiil
Secretary—K.W. Conaty

Program Directors

Forest Protection Research: Dr. S.S. Malhotra
Secretary—K.W. Conaty

Forest Resources Research: R.M. Waldron
Secretary—R.B. Bown

Forestry Extension: Dr. J.M. Powell
Secretary—R.B. Bown

Regional Development: Dr. M.J. Heit
Secretary—R.B. Bown

Regional Manager, Management Services: P.G. Stewart
Secretary—R.B. Bown

FOREST PROTECTION RESEARCH

Dr. S.S. MALHOTRA

Project	Title	Professional Staff	Technical Staff
NOR-7	Environmental effects of toxic substances and vegetation management	Dr. P.A. Addison *(Project leader to Oct. 1985)* Dr. S.S. Sidhu *(Project leader from Nov. 1985)* Dr. M.J. Apps J.C.Y. Feng Y.P. Kalra Dr. D.G. Maynard	M.D. Fairbarns L.J. Milward *(From March 1986)* F.G. Radford J.I. Ridgway J. Shuya
NOR-11	Forest insect and disease surveys and management systems	Dr. B.H. Moody *(Project leader)* P.A. Amirault *(From July 1985)* Dr. H.F. Cerezke Dr. Y. Hiratsuka Dr. H.R. Wong H. Zalasky	F.J. Emond H.S. Gates P.J. Maruyama G.N. Still D.L. Szlabey R.C. Tidsbury

Project	Title	Professional Staff	Technical Staff
NOR-28	Wetlands, climate, and ENFOR	S.C. Zoltai *(Project leader)* Dr. G.R. Hillman J.D. Johnson Dr. T. Singh	M.W. Ali E.B. Robson N.B. Schultz

FOREST RESOURCES RESEARCH

R.M. WALDRON

NOR-4	Stand productivity and forest inventory	Dr. I.E. Bella *(Project leader)* Dr. J. Baker H.S. Grewal R.J. Hall W.C. Moore W.J. Ondro *(From Sept. 1985)* Dr. R.C. Yang	S.J. Lux T.J. Walsh
NOR-10	Regeneration and plantation management	L.G. Brace *(Project leader)* Dr. I.G.W. Corns W.D. Holland W.G.H. Ives	D.T. Allan J.A. Drouin J.R. Gorman C.L. Rentz
NOR-12	Nursery management and tree improvement	Dr. I.K. Edwards *(Project leader)* Dr. I.J. Dymock E.M. Harvey Dr. J.I. Klein	P.B. Chapman *(From July 1985)* F.M. Dendwick W.M. Mills J.J. van Dyk

FORESTRY EXTENSION

Dr. J.M. POWELL

NOR-5	Fire management systems and guidelines	Dr. R.J. Barney *(Project leader from July 1985)* M.E. Alexander Z. Chrosciewicz G.P. Delisle B.S. Lee R.S. McAlpine W. Vanderschuit *(From Oct. 1985)*	E. Kuyt M.E. Maffey C.J. Ogilvie R.M. Smith

Project	Title	Professional Staff	Technical Staff
NOR-13	Forest hydrology and microclimate research	Dr. R.H. Swanson *(Project leader)* Dr. P.Y. Bernier	Z. Fisera P.A. Hurdle
NOR-33	Technology transfer and information	R.G. Newstead *(Project leader)* A.C. Ascher *(From Dec. 1985)* B. Boughton *(From Dec. 1985)* A.M. Keeling *(Resigned Oct. 1985)* D.J.S. Robinson J.K. Samoil G.B. Turtle *(Resigned Sept. 1985)*	D.J. Adams J.H. Baker P.S. Debnam E.M. Hopp D.D. Lee S.S. Phillips H.M. Stewart
NOR-53	Computing and data processing services	W. Chow *(Project leader)* A.W. Irwin A.J. Paradis *(From Oct. 1985)* T. Tan *(Resigned July 1985)*	L. Hai

REGIONAL DEVELOPMENT

Dr. M.J. HEIT

NOR-3	Resource economics and statistics	D.M. Boylen *(Project leader)* J.P. De Franceschi D.H. Kuhnke A.M. Mauch *(From July 1985)* T.B. Williamson	R.A. Bohning
NOR-36	Development agreements	H.S. Price *(Project leader)* R.M. Coté *(From Sept. 1985)* J. Mrklas	
NOR-54	Management of regional development program	Dr. M.J. Heit *(Project leader)*	

	Professional Staff	Technical Staff
Saskatchewan District Office (Prince Albert)	J.J. Farrell *(District manager)*	M.D. Adamson *(From Sept. 1985)*
	G.R. Barth *(From Sept. 1985)*	K.P. Bacon
	W.J. de Groot *(From May 1985)*	J.H. Johnston *(From Sept. 1985)*
	A.C. Gardner *(From Aug. 1985)*	D.M. Sidders *(From Sept. 1985)*
	C.A. Lee	P.E. Taylor *(From June 1985)*
	M.E. Newman *(From Aug. 1985)*	S.F. Urquhart *(From Feb. 1986)*
Manitoba District Office (Winnipeg)	J. Davidson *(District manager to July 1985)*	C.B. Brown *(From May 1985)*
	J.A. McQueen *(District manager from July 1985)*	J.R. Dyck
	W.J. Ball	M.G. Grandmaison
	K. Froning *(Deceased in Sept. 1985)*	V.S. Kolabinski
	K.G. Hirsch	V. Lebedeff
	T.W. Steele	A. Nanka
	Dr. W.J.A. Volney	B.I. Schlawitz
	D.R. Witt	S.M. Sokol
		N.R. Walker

MANAGEMENT SERVICES

P.G. STEWART

Position	Staff
Head, financial services	F.F. Allen
Finance officer	B.D. Weiss
Finance clerks	K.L. Briscoe-Adams
	L.A. Bayrak
	R. Eckert *(Resigned April 1985)*
	J.J. Iskra
Purchasing officer	J.E. Hodgins
Purchasing clerk	T.Y. Avenell
Storesperson	G.R. Fawcett
Vehicle clerk	J.L. Wake

Position	Staff
Supervisor, office services	D.M. Burke
Records office supervisor	A.R. Fulton
Records clerk	M.K. Sampson
Word processor operators	E. Schiewe
	J.M. Simunkovic
Stenographer	S. Ratansi
Receptionist-typist	T.B. Phillips
Head, physical facilities	H. Schoendube
Chief engineer	R.J. Fisher
Maintenance engineers	A. De Costa
	W.B. Lybbert
Senior maintenance craftsman	S.T. Colistro
Maintenance craftsman	G.K. Burton
Groundskeeper	G.M. Schmidt
Electronics technician	P. Bihuniak

PERSONNEL

(Agriculture Canada employees located at the Northern Forestry Centre)

Personnel advisor	R.P. Czuj
Pay and benefits clerk	B.M. Grauman
Personnel clerk	M.C. Grbavec

APPENDIX C

EXPENDITURES 1985–86

Program area	Person-years	Salaries ($000)	Operations & maintenance[a] ($000)	Capital ($000)	Contributions ($000)	Total ($000)
Directorate	6.0	296.0	104.8	1,119.7	—	1,520.5
Management services	25.5	731.3	651.7	—	—	1,383.0
Forest protection	29.0	1,141.7	108.5	—	—	1,250.2
Forest resources	28.0	1,060.5	142.2	—	—	1,202.7
Forestry extension	28.0	945.6	250.7	—	—	1,196.3
Regional development	8.5	483.1	63.6	—	—	546.7
ENFOR[b]	—	—	60.2	—	—	60.2
Manitoba agreement	12.5	348.9	322.1	1,184.2	1,069.3	2,924.5
Saskatchewan agreement	9.0	189.7	341.5	1,579.3	624.0	2,734.5
Alberta agreement	5.0	47.6	328.5	21.5	875.9	1,273.5
Job creation	3.0	84.0	33.9	—	—	117.9
NOGAP[c]	—	—	43.4	—	—	43.4
PRUF[d]	—	—	180.2	—	—	180.2
Student employment program	—	132.9	—	—	—	132.9
Cost-shared agreements[e]	—	—	24.0	—	—	24.0
Total	154.5	5,461.3	2,655.3	3,904.7	2,569.2	14,590.5

[a] Includes contracts; see Appendix E.

[b] ENergy from the FORest, funded by Energy, Mines, and Resources Canada.

[c] Northern Oil and Gas Action Program.

[d] Program of Research by Universities in Forestry.

[e] See Appendix D.

APPENDIX D

COST-SHARED AGREEMENTS 1985-86

Funding agency	Program	Project	Operations & maintenance ($)
Canterra Energy Ltd.	Monitoring of sour gas	NOR-7 (Addison)	24,000
Total			24,000

APPENDIX E

CONTRACTS LET OR SUPERVISED AND EXPENDITURES IN 1985–86

Contractor	Title	Amount ($)	Scientific authority
Alberta Energy and Natural Resources Postal Bag 6343 215 McLeod Avenue Spruce Grove, Alberta T0E 2C0	Control of aspen development in areas designated for softwood production—plot establishment and initial sampling[d]	49,010	L.G. Brace
Alberta Forest Service Alberta Energy and Natural Resources 9th floor, Bramalea Building 9920 - 108 Street Edmonton, Alberta T5K 2M4	Wetland and drainage improvement—Phase I[d]	41,000	G.R. Hillman
Alberta Forestry Association 311 Alberta Block 10526 Jasper Avenue Edmonton, Alberta T5J 1Z7	Preparation and printing of an updated version of *Alberta Trees of Renown*[d]	8,250	R.G. Newstead

Continued on next page

APPENDIX E continued

Contractor	Title	Amount ($)	Scientific authority
Atmospheric Environment Service Suite 1000, 10th floor 266 Graham Avenue Winnipeg, Manitoba R3C 3V4	Saskatchewan fire weather station evaluation[f]	11,923	J.J. Farrell
Barta Tree Farms Box 43 Hadashville, Manitoba R0E 0X0	Collection of pollen samples[e]	9,800	A. Nanka
Callaham, Dr. R.Z. 26 St. Stephen Drive Orinda, California 94563	Advise on program development and implementation related to technology transfer	3,568	A.D. Kiil
Farrington, Peter 10662 - 65 Street Edmonton, Alberta T6A 2P2	Chemical analyses of precipitation, throughfall, leachate, and litter samples from selected aspen plots[a]	8,040	I.K. Edwards
Fedorus, J. P.O. Box 241 Slave Lake, Alberta T0G 2A0	Collect water and litter samples near Kinuso, Alberta[a]	3,295	I.K. Edwards

Forintek Canada Corp. Western Laboratory 6620 N.W. Marine Drive Vancouver, B.C. V6T 1X2	A study of the size, structure, and socioeconomic impact of wood-using industries in the province of Alberta	65,013	J.J. Farrell
Griffith, C.L. #201, 511 - 56 Avenue S.W. Calgary, Alberta T2V 0G6	Statistical analysis and computer synthesis of soil chemical and plant analytical data	4,965	P.A. Addison
Hayward, Roger 8 Vardana Place N.W. Calgary, Alberta T3A 0C5	Analysis of soil samples and plant material	6,800	D.G. Maynard
Hayward, Roger 8 Vardana Place N.W. Calgary, Alberta T3A 0C5	Preparation of vegetation and soil samples for chemical analysis	5,162	S.S. Sidhu
Hershberger, Alvin General Delivery Calling Lake, Alberta T0G 0K0	Collection of water and litter samples and delivery of these to Edmonton[a]	2,020	I.K. Edwards
I.D. Systems Ltd. 966 Waverley Street Winnipeg, Manitoba R3T 4M5	Biomass and energy potential of main tree species in Manitoba—Phase III[a]	11,770	T. Singh

Continued on next page

APPENDIX E continued

Contractor	Title	Amount ($)	Scientific authority
Intergroup Consultants 604, 283 Portage Avenue Winnipeg, Manitoba R3B 2B5	Prepare an evaluation framework for the Canada-Manitoba Forest Renewal Agreement[e]	14,993	J. Davidson
Johnson Forestry Services 419 Parkvalley Drive S.E. Calgary, Alberta T2S 4V3	A review of forest research studies conducted in Manitoba and Saskatchwan to 1970[e,f]	2,225	J.J. Farrell & J. Davidson
Lakehead University (Dr. R.J. Day) Postal Station P Thunder Bay, Ontario P7B 5E1	Evaluate the utility of glyphosate herbicide for control of trembling aspen in a white spruce plantation in the boreal mixedwood[b]	13,455	W.J. Ball
Macen, Joanne 11403 - 80 Avenue Edmonton, Alberta T6G 0R6	Recording and analysis of tree physiology data	3,990	I.J. Dymock
McAlpine, Caroline P.O. Box 595 4503 - 48 Street Beaumont, Alberta T0C 0H0	Hazard rating system for forest pests[d]	9,729	P.A. Amirault

McNabb, Robert c/o Band Office Moose Lake, Manitoba R0B 0Y0	Plant white spruce bare-root stock[e]	7,540	J. Davidson
New Horizons Productions 4611 - 37B Avenue Edmonton, Alberta T6L 3S8	Preparation of an audiovisual production on insect and disease identification[d]	3,500	P.A. Amirault
Niederleitner, S. 10360 - 144 Street Edmonton, Alberta T5N 2V2	Hazard rating system for forest pests[d]	9,649	P.A. Amirault
NORPLAN Consulting Bell and Associates Box 228 LaRonge, Saskatchewan S0J 1L0	Evaluation study of economics of utilization of Saskatchewan hardwoods[f]	23,325	A.M. Mauch
Perron, Richard #12C, 915 Corydon Avenue Winnipeg, Manitoba R3W 0W9	EDP professional services	2,950	J.A. McQueen
Redekopp, Todd 21 Bocock Place St. Albert, Alberta T8N 2K3	Hazard rating system for forest pests[d]	5,250	P.A. Amirault

Continued on next page

APPENDIX E continued

Contractor	Title	Amount ($)	Scientific authority
Silvacom Limited 9868A - 33 Avenue Edmonton, Alberta T6N 1L6	Canadian permanent sample plot catalogue[d]	3,950	D.H. Kuhnke
University of Alberta (Dr. J. Beck) Edmonton, Alberta T6G 2J9	An economic analysis of the Alberta timber supply[d]	50,000	D.M. Boylen
University of Alberta (Dr. P. Kershaw) Department of Geography Edmonton, Alberta T6H 3S5	Studies of environmental effects of disturbances on the subarctic (SEEDS)—Phase I[c]	43,447	S.C. Zoltai
University of Alberta (Dr. E. Phillips) Edmonton, Alberta T6G 2J9	Climatology of atmospheric conditions related to extreme fire behavior[b]	29,123	M.E. Alexander
University of Alberta (Professor W. Phillips) Edmonton, Alberta T6G 2M7	An assessment of nonmarket benefits in a value-at-risk framework for fire management[b]	20,330	D.M. Boylen

University of Alberta (Dr. D.J. Pluth) Edmonton, Alberta T6G 2J9	Amelioration of subsurface horizons of luvisolic soils through mechanical disruption[b]	14,030	W.D. Holland
University of Alberta (Dr. D.J. Pluth) Edmonton, Alberta T6G 2M7	Development of lodgepole pine and white spruce site index curves[b,d]	74,757	I.G.W. Corns
University of Alberta (M. Sharma) Edmonton, Alberta T6G 2M7	Study of fertilization trials of lodgepole pine	1,560	W.J. Ondro
University of Manitoba (Dr. J. Reid) Winnipeg, Manitoba R3T 2N2	Intrastructural study of host-parasite interactions of western gall rust[b,d]	19,988	Y. Hiratsuka
Western Archrib 4315 - 92 Avenue Edmonton, Alberta T6B 3M7	A study of the use of Alberta spruce and pine in the manufacture of laminated beams[d]	12,760	R.M. Coté
Western Ecological Services Ltd. #205, 3347 Oak Street Victoria, British Columbia V8X 1R2	Adaptation of nutrient cycling data to the FORCYTE growth simulation model for aspen stands[a]	22,700	I.K. Edwards
Total		619,867	

[a] ENergy from the FORest (ENFOR) contract.
[b] Program of Research by Universities in Forestry (PRUF) contract.
[c] Northern Oil and Gas Action Program.
[d] Canada-Alberta Forest Resource Development Agreement.
[e] Canada-Manitoba Forest Renewal Agreement.
[f] Canada-Saskatchewan Forest Resource Development Agreement.

APPENDIX F

PUBLICATIONS 1985–86

(As of March 31, 1986)

Achuff, P.L.; Corns, I.G.W. 1985. Plants new to Alberta from Banff and Jasper national parks. Can. Field-Nat. 99(1):94–98.

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Gorman, J.R., compiler. 1985. Proceedings of the 1984 Mechanized Silviculture Workshop. Can. For. Serv., North For. Res. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-272.

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